DOCUMENT RESUME

ED 054 950 SE 012 386

TITLE Science in the Primary School, Field Report No. 5

INSTITUTION Schools Council, London (England).

PUB DATE 67

NOTE 7p.

EDRS PRICE MF-$0.65 HC-$3.29

DESCRIPTORS *Curriculum; Educational Trends; *Elementary School Science; *Inservice Teacher Education; International Education; Teacher Education

IDENTIFIERS *England

ABSTRACT

A sketch of the trend to install science in English elementary schools in terms other than "watered-down" secondary school courses introduces a description of the status of these efforts in 1967. Descriptions of the Nuffield Junior Science project, the Froebel Foundation study of science behavior in young children, and the initiation and function of Teachers' Centers are given. Discussion of the support that teachers will need in increasing their knowledge of science and providing sufficient classroom equipment to facilitate the development of student-initated investigations precedes a brief mention of the problems of producing elementary school teachers who are confident and competent in the use of science as an educational tool. (AL)

ED054950

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FIELD REPORT No. 5

Science
in
the Primary School

SE 012 386

THE SCHOOLS COUNCIL

38, BELGRAVE SQUARE, LONDON, S.W.1.

Background

In two decades, the primary school has witnessed a remarkable development and extension of traditional nature study into a much broader examination of the environment. Indeed, it has now become a study of nature in the broadest possible terms, embracing much of physics, geology, meteorology, and any other aspect of science that young children can reasonably study.

Since the end of the war there has been growing interest in the subject, and hand in hand with other areas of the curriculum, considerable advances have been made. Notably, it has developed in parallel with the teaching of mathematics, although there are several significant differences.

For example, the initial changes in attitude towards mathematics teaching were brought about through an intensive drive by the Ministry of Education, acting largely through a small group of H.M. Inspectors, who worked most effectively through national and regional courses. These courses, which have gone on continually from the late 1950s to the present day, prepared the ground for the extensive curriculum development that was to come later, and they ensured that a large section of the teaching population was at least aware of modern developments in this field. In addition, they produced a small but enthusiastic group of teachers, lecturers and administrators who were competent to act as staff tutors at further courses. The people responsible for organising courses were also able to draw upon vast resources of experience, with the result that courses became even more sophisticated and effective.

Ultimately the accumulated knowledge and expertise was condensed into the Schools Council's *Curriculum Bulletin No. 1* which could then be presented to a teaching profession prepared to accept it and to use it effectively.

In the field of science, however, there had been no large scale preparation for new approaches to teaching, although in 1959, the Ministry of Education, aware of a growing interest amongst teachers, ran its first primary school science course based upon investigations by children. This was to become an annual event, but there was still nothing to compare with the series of mathematics courses being organised by Miss E. E. Biggs, H.M.I., and her co-workers. Most of the development in science went on in a few local authorities, a few schools, but mostly in isolated classrooms where there were enthusiastic teachers.

There was, of course, a spate of books about science, aimed at primary school children and their teachers, but usually these took the form of collections of simple experiments for the children to do, often with supporting texts giving information and scientific facts. The writers were still thinking mainly in terms of how to adapt secondary school science courses to meet the needs of primary school children.

However, there were a few publications which were outstanding in that they pointed the way towards a form of scientific study more closely related to what was known about very young children and how they learn, and because they related the subject to forward looking educational practice. Such were the *Ministry of Education Pamphlet No. 42*, 'Science in the primary school' (1961); the booklet produced by John Murray, 'Science in the primary school' (1959); and the Educational Supply Association publication 'Approaches to science in the primary school' (1960).

By the late 1950s interest was growing rapidly. In 1961 the British Association and the ATCDE jointly sponsored a conference in London. In 1963 the newly constituted Association for Science Education, decided to establish a Primary Schools Committee to consider how it could help primary school teachers and at the same time ensure the maintenance of a high quality of science as well as of science teaching. The Schools Nature Study Union also enlarged its scope and became the 'Schools Natural Science Society'.

Development

Then came an eruption of curriculum development projects. The Ministry of Education allocated a small grant to support research into the establishment of scientific concepts in young children, the work being based on the Oxford University Institute of Education. The Froebel Foundation, sponsored by the British Association, launched a co-operative scheme for the study of scientific

behaviour in young children. The work was directed by the late Nathan Isaacs and the first part of its report was published in 1966.[1]

The largest of these projects was established when the trustees of the Nuffield Foundation decided to add a Junior Section to the three 'O' level projects it was already supporting. This project was jointly sponsored by the Schools Council, which provided a lot of the supporting services, especially in the fields of in-service training and local liaison work.

All these groups had certain ideas in common. For example, they were all concerned about children learning with understanding and were all wedded to the idea of pupils investigating practically at first hand. None of them wanted to see a watered down version of secondary school science imposed on the primary school. The Froebel Foundation group, the Nuffield project, and the ASE committee all stressed the importance of science being a way of working as much as a subject to be studied and saw in scientific activity an invaluable part of an integrated approach to learning. The Oxford group, unlike the others who had begun from a consideration of the child, started from the opposite pole, trying to define a few fundamental scientific ideas and then considering how they might be taught effectively.

The Nuffield project

Probably the project which has had the most far-reaching effect, because of its greater size and resources, is the Nuffield Junior Science project, which was directed by Mr. E. R. Wastnedge This advocates an essentially child-centred approach, suggesting to teachers that they should help children to isolate their own problems, devise their own investigations, design and make their own apparatus, form their own conclusions and then communicate them. It sees the curriculum as an undifferentiated one, with scientific investigation being used as a particularly potent educational tool. In this philosophy it is at one with the Froebel group, and almost entirely so with the ASE committee. It also receives considerable support from many primary school teachers, administrators, and H.M. Inspectors and college lecturers, although there is necessarily a good deal of variation of opinion on details within the general philosophical framework.

Like the report of the Froebel Co-operative Scheme, the Nuffield Junior Science materials are the product of a study undertaken by practising teachers. The project team studied conditions in a number of classrooms and wrote sample materials which they then submitted for trial in schools. The trials were organised by the Schools Council and involved teachers in 12 local education authority areas in England and Wales as well as three in Northern Ireland and one in Scotland. The project was launched in 1964 and the trials took place in 1965-6. In September 1966 a further 35 local education authorities were offered the trial materials for use in a limited number of schools.

Each trial area had its own leader who 'fed back' to the project the opinion, critical appraisal, and suggestions of the trial teachers, together with examples of some of the work done in the schools. Armed with this advice, the Nuffield team was then able to rewrite its materials in a much modified and greatly extended form, ready for publication in August 1967. The project itself ended in December 1966.

But the work of the project involved far more than writing books and testing their effectiveness in schools. The method of teaching being advocated was one which made great demands on the teacher for it set a premium on flexibility and on following children's own interests. Whether it was accepted wholly or in part, it demanded that teachers should examine and re-appraise their own role in the classroom, and for very many teachers it might lead to an unwillingness to try it because of their feelings of uncertainty and insecurity in this new situation. It was necessary, therefore, to prepare the teachers beforehand so that they could make a valid appraisal of the materials they were to test.

The preparation was done largely through a series of national courses, initiated by the Schools Council, organised by H.M. Inspectors and staffed by the Nuffield team together with a few teachers, administrators and lecturers. Each trial area sent a few selected teachers and administrators to the courses where they had a chance to experience, at their own level, the approach that they would be trying to implement in school. In addition, they were given ample time to discuss their problems in small groups and in general forum. They were then expected to return to their home areas where they could help to train more of their colleagues.

[1] 'Children learning through scientific experience'—Froebel Foundation.

In addition, each local education authority participating in the trials agreed to set up a centre where teachers could meet to discuss their work, try out experiments, attend courses, hear lectures, or indeed become involved in any one of a number of activities which were likely to help them in their professional work.

This work had some far reaching effects. For the first time ever, more than a thousand teachers were personally involved in a piece of curriculum development. They were having to direct their attention to considering how children learn and they were contributing to the production of materials which could have a great influence on the nature of primary school teaching. Some of them were forming study groups to consider particular problems. Many of them were prepared for the very first time to air their classroom difficulties in public. They found to their surprise that these problems were often shared by their colleagues and that through co-operation they could be solved.

The teachers' centres were probably the most important development of all. The exchange of ideas was stimulating and the range of activities which could go on there went beyond the boundaries of science, or mathematics, and even beyond the range of primary school itself, for in the teachers' centre, primary and secondary teachers could meet and help each other.

For the first time, too, there was a concentration of the knowledge and experience of primary schools and science teaching. Individuals from all areas of the educational field were asked to contribute to a common problem and the resultant effect was, of course, far greater than the sum of the individual contributions.

The present situation—1967

The present situation, then, is that the ASE committee, the Froebel Foundation, and the Nuffield Project, with the support of the Department of Education and Science and the Schools Council, have focused attention on the major problems associated with science teaching in the primary school and have produced, or are producing, assistance for teachers. It is significant that none of them has produced kits of apparatus or lists of experiments for the children. Instead, each of them has tried to help the child by influencing the teacher through example and suggestion aimed at changing his own attitude.

The general trend is towards individual or small group investigation by the children themselves based upon the children's own questions and interests. Subject boundaries are crossed and timetable limitations are increasingly overcome as teachers and children find that the isolation of science as a subject becomes more and more unrealistic and inconvenient.

There are many problems still to be solved. As the various interested groups have tackled the immediate general educational problem, many more specific ones have been revealed. Not the least of these is the development from the essentially unstructured approach of the primary school to the more structured one of the secondary school. How does the child make this transition? How can we cater for the boy who makes the change when he is only nine, and the one who should not have a structured course until he is 15? Related to this is the increased flexibility of the age of transfer from primary to secondary education and the establishment of middle schools. There are many problems of this kind and the Council has established a continuation project, which, from September, 1967, will be able to look in more detail at a few of them.

Probably the teachers' centres could play an active and valuable part here. There are already many teachers who are experienced members of study groups and there are still more who would join in with enthusiasm. It would be a shame if the enthusiasm aroused by the curriculum development projects were to be allowed to subside or dissipate itself unproductively. Some carefully defined problems might well be given to regional study groups for them to examine and report on. Indeed, educational problems concerned with child development and behaviour can only be studied by observers in classrooms, and who better than the teacher on the spot? But apart from purely educational problems requiring scientific investigations, there are a number of organisational ones concerning the training of teachers, and then there is the question of help and support for teachers once they have been trained.

All the development projects together cannot have had a direct effect on more than two thousand practising teachers, who as a result may have modified their approach to teaching. What is to become of all the other thousands of practising teachers? They already have freely available to them the

published materials of the Froebel and ASE groups, and soon they will be able to buy the Nuffield books. Experience has shown that if teachers are really to be helped they will need to have more than printed words. It is essential that they should experience for themselves the learning approach that they are expected to use with their classes. This means extensive practical courses. Experience has also shown that the most successful development has taken place in those areas where there has been a local education authority adviser or inspector—someone on the spot—to whom teachers could turn for help and advice *after* they had attended a course, and when they began to meet difficulties in the classrooms.

Support for teachers through courses

Given sufficient courses and local advisers, the whole of the primary school teaching force could be helped. What can be done, and how, in the next few years?

Clearly, if all the areas who wish to extend what they have already started, and all the areas who buy Nuffield publications in August, wish to send teachers to national courses of training, the Department of Education and Science would be faced with an impossible task. The necessary accommodation facilities and the large number of trained and experienced staff required simply do not exist. So that, although *some* help and guidance could be given at national level, it is obvious that other solutions must be found.

With this in mind the Schools Council has written to a number of the people concerned asking them to be prepared to organise or help with courses for teachers interested in finding out more about the Nuffield project materials. LEAs and colleges of education have been asked if they will release members of their staff for this work; and it is hoped that LEAs whose teachers have had experience with the Nuffield materials will welcome visits to their schools from teachers in other areas. Thus the expertise of the pilot schools in the Nuffield project areas can be made widely available, and it should be possible for a considerable number of practising teachers to see at first hand other teachers using the Nuffield materials and be helped to make a start in their own schools. LEAs who would like help in organising introductory primary science courses of this kind should write to the Schools Council, at 38 Belgrave Square, London, S.W.1., for further details.

However efficient this local training machine becomes the need for national courses will not be obviated. Experienced and qualified teachers need to attend more advanced conferences to give them fresh stimulus and enable them to exchange and refine their own ideas.

More knowledge of science

Once teachers have accepted the new approach to science teaching, their immediate cry is for more help with the subject itself. Because of absence of background knowledge, opportunities for starting investigations are missed, or having been started, an investigation peters out because the teacher is not aware of possibilities, does not know which books and materials to introduce, or does not know what kind of questions to ask. The request is usually for more knowledge of the subject, preferably learned by practical discovery methods, although the need is so great that no possibility (lectures, films, books, etc.) must be ignored provided that teachers accept it.

There is a need, therefore, for science courses for teachers and again the demand is so great that this must be done at regional level. Local branches of the ASE with their vast resources of experience, could do a great service in this field; so could secondary science teachers and colleges of education, who might well begin to think in terms of one term tutorial courses for seconded teachers. But it is also essential that local authorities should appreciate the need to release teachers for a day or half day each week, and that teachers should be prepared to reciprocate by giving up an occasional evening or week-end.

Other support for teachers is also available:

The books published by the ASE, Froebel Foundation (see page 1), Nuffield project etc.:

(i) The *Science for primary schools* series, published for the ASE by John Murray Ltd.
   1. Children learning through science
   2. List of books
   3. List of teaching aids
   4. Materials and equipment

(ii) The Junior Science project materials published by William Collins, Sons & Co., Ltd. on behalf of the Nuffield Foundation.

Teacher's guide 1
Teacher's guide 2

Source books
Apparatus
Animals and plants

Background booklets
Autumn into winter
Science and history
Mammals in classrooms

Three more background readers are being produced by the Nuffield Foundation.
Some films are available:

'Into tomorrow'. Available on loan from the Rank Film Library, 1 Aintree Road, Perivale, Middlesex. (30s. per screening. 16mm, black and white, sound film: The work of a class of nine-year-olds in a city developing over half a term—28 minutes.)

'Science in a rural primary school'

'Science in a city school'

Two 16mm. black and white sound films of about 20 minutes each—one filmed in Northumberland and the other in London. They are available from the Newcastle Institute of Education at £25 each.
'Science in the primary school'—a BBC TV series of five thirty minute broadcasts on present activity, including the Nuffield project.

'Discovery and experience'—a BBC TV series of ten thirty minute broadcasts showing the use of discovery and experience methods of learning in a variety of subjects and activities, which also looks at the theory behind the practice.

Both series are available from BBC Television Enterprises (Director, Brian Keyser), BBC Television Centre, London, W.12, at a cost of £45 for each half-hour programme.

Classroom support

What kind of materials and support will they need in their classrooms? The Nuffield project asked trial area authorities to supply each other with a set of basic materials. These included such items as spring balances, magnets, magnifiers etc., and although this may seem expensive when extended to every classroom, there is no doubt that they do enable children to carry on with their scientific studies. The other need is for a small amount of ready money to be available for buying expendable materials as and when necessary. Lack of working materials results in frustrated and abortive scientific enquiry. It requires a new outlook on the responsibility of teachers for organising their own requisitioning and spending, but it could result in a more responsive and responsible attitude from teachers

The books that children are going to need will be rather different from those generally produced at the moment. As the free ranging investigation approach gains ground, children want more and more books giving general background information as well as more specific ones, like those for identification of animals or plants or rocks, etc. The traditional book of experiments is no longer likely to be in demand.

Initial training

There still remains the vast problem of the initial training of teachers. The colleges of education are torn between the demands of 'education' and 'main' courses and of curriculum courses which must try to cover all that the primary school teacher as a non-specialist has to teach. This is not the place for a detailed discussion of initial training but clearly the curriculum in the colleges must be such that they produce a flow of teachers who are competent and confident in the use of science as an educational tool. Unless this can be ensured, the money spent on curriculum development and the energy used in helping practising teachers will be to no avail.

APPENDIX

PILOT AREAS FOR THE SCIENCE PROJECT

Carlisle
Yorkshire (West Riding)
Liverpool
St. Helens
Essex
ILEA
Leicester
Anglesey
Birmingham
Kent
Bristol
Cardiff

Consultative Area

Lincolnshire (Kesteven)

The Second Phase Areas

Wakefield
Lincoln
Doncaster
Middlesbrough
Sussex (West)
Somerset
Solihull
South Shields
Durham
Lancashire
Rochdale
Southport
Bolton
Bradford
Tynemouth
Wallasey
Blackburn
Yorkshire (North Riding)
Leeds
Kingston-upon-Hull
Nottinghamshire
Derbyshire
Derby
Leicestershire
Warwickshire
Walsall
Wolverhampton
Stoke-on-Trent
Norfolk
Sussex (East)
Croydon
Hillingdon
Buckinghamshire
Bournemouth
Wiltshire
Plymouth
Cornwall
Gloucestershire
Newport (Mon.)

Printed for Her Majesty's Stationery Office by McCorquodale & Co. Ltd.
HM 1876. Dd. 381505. 100M. 8/67 McC. 3309.